

HOW TO LEARN MORSE

G.N.T.





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GREAT NORHTERN TELEGRAPH WORKS

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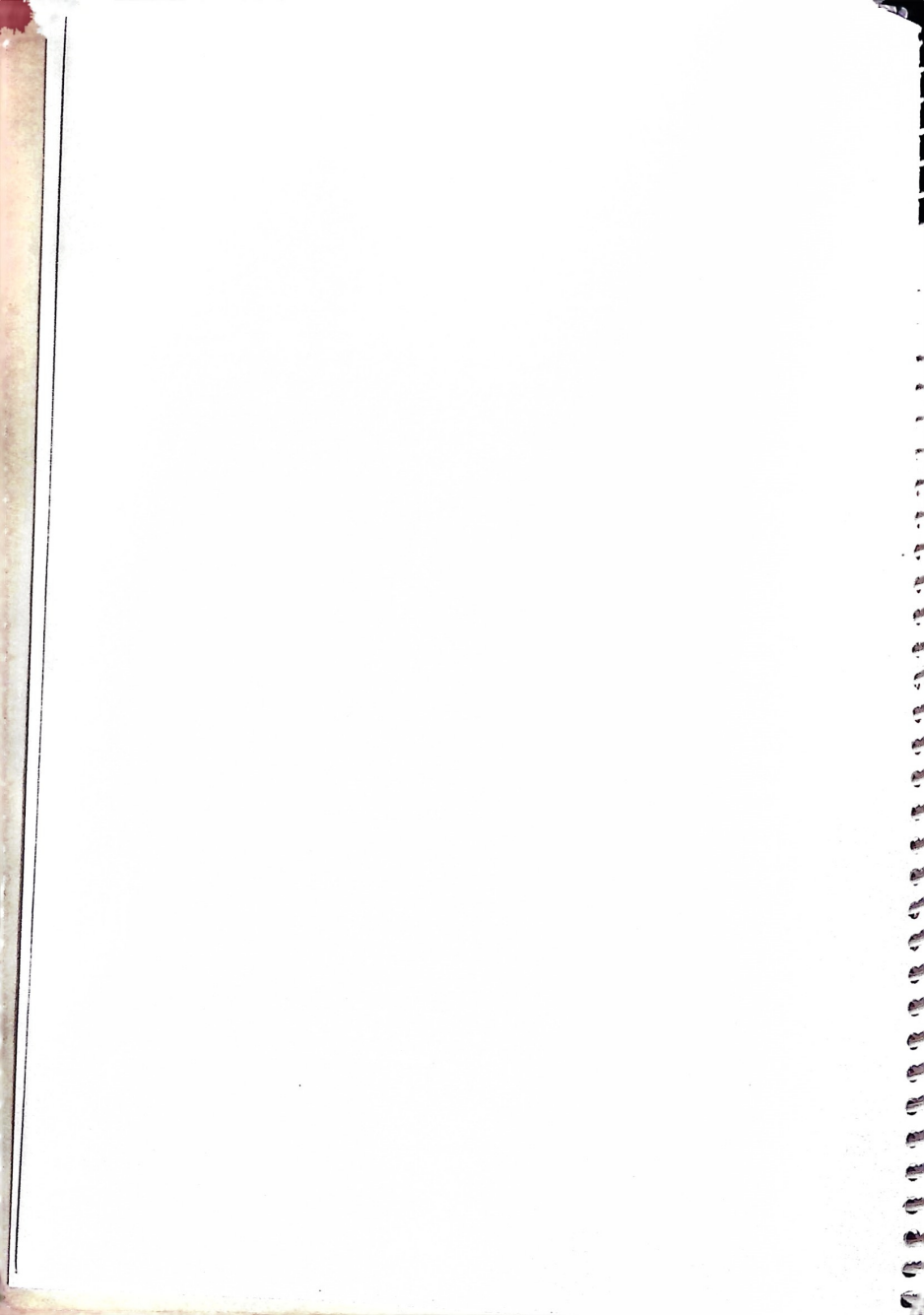
FOREWORD

The Morse code is no longer used in telegraphy to the same extent as some years ago, but has given way to direct printing systems based on the 5-unit (teleprinter) code. However, the Morse code has a wide field of application in radio telegraphy on ships, and on airplanes. Radio amateurs also employ the Morse code for communication. Also, in the armed forces is Morse used and a special application is in the military police in countries with large territories where widely spaced stations communicate by means of the Morse code.

This little book is written with a view to guide those responsible for training Morse operators. It is our opinion that proper proficiency in Morse operation can be obtained only when the pupil attends a properly organized course of instruction, and it is our experience that the better a training school is equipped with equipment, i. e. tape transmitters and Morseinkers, the quicker will the students attain the required standard of efficiency. The problem is ultimately reduced to an economic one because the acquisition of up-to-date equipment simply pays in the sense that it reduces the time required for training.

While this booklet is mainly concerned with training Morse operators we have also included a few pages on automatic Morse equipment because we find that it could be useful for those who have learned the Morse code to know how the code is used in automatic high speed telegraphy. Furthermore, we have considered it of use to the readers to include in the book mention of the most up-to-date equipment in the form of telegraph instruments used in a Morse training school.

September, 1960.



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DIAGRAMS

- No. I: Training School for Morse Telegraphy and Radio Telephony
- No. II: Student's Working Table (keytraining with Morseinker and headphones)
- No. III: Student's Working Table (keytraining from master signals - split listening)
- No. IV: Student's Working Table (telephone service)
- No. V: Student's Working Table (complete schematic wiring diagram)



Receiving Morse Code

LEARNING THE CHARACTERS

It is a very widespread view among beginners that if you want to learn the Morse alphabet you must get a code list and then fix in your mind how many dots and dashes each letter contains and in which order.

This is fundamentally wrong.

If you learn the Morse characters in that manner you will always — when listening to signals — split these up in a certain number of elements, in dots and dashes, whereafter you in your head convert into normal letters according to the Morse alphabet.

This method should never be used.

First of all you must forget all about such schemes and lists; in fact you must forget that the Morse letters are combinations of elements.

Each signal should be understood as an indivisible unit, a kind of a rhythm. This means that you have to learn the characters by the ear and solely by the ear. The optical picture of the signals should be quite forgotten.

If this rule is not followed, if the students try to fix the Morse letters in their mind by means of a code scheme or the like, experience shows that difficulties very often arise as the speed reaches 70—100 letters per minute. — In many cases higher speeds cannot be obtained at all without lowering the receiving accuracy.

For this reason a tone generator is very suitable in Morse training schools, but as such an apparatus is not always at hand at the moment where a Morse signal is to be described during the first hours of the education, it is also possible to express the sounds in the following way:

the dots by means of the word "dit", and the dashes by the sound "dah". In order to make the combinations easier to pronounce, the "dit" is shortened to a "di" in cases where it does not form the end of a signal.

The sound "di" resp. "dit" should be pronounced as quickly and precisely as possible and without any stressing. The "dah" is always stressed and the sound "ah" is pronounced like in the word "dark".

For the same reason it is not advisable to record the Morse characters on the black-board, as the pupils hereby may feel tempted to use the optical picture of the signal. Neither should e. g. a "D" be described as a dash followed by two dots. The letter should always be reproduced by means of the loudspeaker or the headphones, by whistling or by using the sound combination "dahdidit".

The learning of each single Morse signal must be so careful and thorough that the pupil perceives and understands for example the combination "dididit didit dididit" in the same natural way as he understands the word "his" when spoken.

The very commonly used "by-heart"-learning of the telegraph signals should be avoided. The "rhythm" of the character has to be picked up as a total unit. For this reason it is usually easier for a musical student to learn the letters than for a person without any talent in this field. Generally speaking you may perhaps say that for a quite unmusical operator it is almost impossible to reach very high receiving and sending speeds.

Formerly it was very common — during the first hours of the education — to let the transmission speed be very low, so that the pupils got the impression of a certain space between the elements of a signal. This method is not advisable.

It has proved to be far better to send the Morse characters already from the first lesson on a reasonably high speed, for instance 80 letters per minute (corresponding to 16 words per minute) and then to increase the spaces between the signals, thus enabling the students to memorize and write down the letters.

For this purpose a tape transmitter which automatically inserts pauses between the signals and the words transmitted is of invaluable importance. By means of such an instrument the teacher is able to reduce the effective speed from the said 80 letters per minute to for example 50 or 25 letters per minute.

The increased spaces between the characters can be reduced successively according to the progress of the pupils, and it is not necessary to increase the transmitting speed itself until the normal space between letters and words is fully mastered.

Experience proves that this method of education in a very high degree improves the possibilities of reaching high speeds.

Corresponding results may, of course, be obtained with an ordinary transmitter by using a tape especially produced with increased spaces between letters and words, but this method requires that the school has many series of training tapes at its disposal, viz. one series for each of the speeds used during the education time.

As a whole it is recommended to use perforated tapes and transmitters in all Morse training schools. No matter how clever a teacher or an assistant is, he will never be able to obtain the mechanical precision of a transmitter, and even smaller incorrectnesses in his manual sending may cause troubles — importing to the students a wrong picture of the true rhythm of the signal.

The fact that the use of a transmitter — and preferably a transmitter including a device for automatic insertion of increased space between letters and words — means enormous facilities in the work of the teacher, needs no further explanation.

COPYING MORSE SIGNALS

A condition of becoming a skilled operator is that the student is able to write (in longhand) distinctly and quickly. In fact it is not much worth being able to read rapid code in your head if you cannot transcribe the message correctly to paper.

Very often, this question is somewhat neglected at telegraph schools in spite of its importance.

At low speeds (up to about 12 words per minute) it should usually not be difficult to follow the incoming signals, no matter which manner of writing is used, but beyond that limit it is absolutely necessary to comply with some general rules if the students shall be able to keep step with the speed and at the same time write in a clear and legible manner. One single incorrectness may f. inst. in a code word spoil the meaning totally.

A wrong or constrained way of writing may furthermore often involve writer's cramp or synovial sheath inflammation when the speed is increased.

The teacher should see that the students' position is upright, but relaxed, that the position of the arms and hands is correct, and that the handwriting is smooth and without unnecessary flourish. It should be carefully

impressed that copying at higher speeds must go on continuously and not by fits and starts.

The use of printed letters is only possible at rather low speeds, but as some institutions etc. claim that the operator is able to copy the messages in printed letters — to protect against misreadings in code telegrams etc. — it may in some cases be expedient to let the pupils practice also this manner of writing.

Certain letters need special attention when normal hand writing is used, for instance "e" and "l" which letters are very often confused with each other in cases where the difference of height is not clearly emphasized. The little "t" ought to be written with a cross in order to avoid confusion with "l". The cross in "q" should be emphasized to distinguish from a "g".

Also pay attention to B - 13, S - 5, U - N, U - V and Z - 2, letters and figures which are often confused.

It is very important that the student is accustomed to a quick and distinct copying of the incoming signals so that he can concentrate all his attention on the understanding of the code sounds. No mental effort should be used on his finger movements.

Another fact about copying Morse signals is to be noticed. Beginners are very often inclined not to write the words letter by letter. They prefer to write the word when it is finished. This method causes the hand writing to lose its requisite precision and, therefore, cannot be recommended.

COPYING BY TYPEWRITER

Up to speeds of about 20—25 w. p. m. a pupil should usually have no special difficulty in copying the incoming messages. Beyond this limit, however, most people meet difficulties, and the use of technical help — in this case a typewriter — should be taken up.

In order to be able to utilize this possibility it is absolutely necessary that the operator masters the touch system. The "2-fingers" system is here useless. It is necessary that the operator has sufficient routine to write consciously, disassociated and without looking at the keys and that he masters a fairly high speed.

In return the use of the typewriter enables the skilled telegraphist to copy the incoming telegrams directly and without getting essentially tired — even at considerable working speeds.

PHONETIC MORSE ALPHABET

a	didah	j	didahdahdah	s	dididit
b	dahdididit	k	dahdidah	t	dah
c	dahdidahdit	l	didahdidit	u	dididah
d	dahdidit	m	dahdah	v	didididah
e	dit	n	dahdit	w	didahdah
f	dididahdit	o	dahdahdah	x	dahdididah
g	dahdahdit	p	didahdahdit	y	dahdidahdah
h	didididit	q	dahdahdidah	z	dahdahdidit
i	didit	r	didahdit		

NUMERALS

1	didahdahdahdah	6	dahdidididit
2	dididahdahdah	7	dahdahdididit
3	didididahdah	8	dahdahdahdidit
4	dididididah	9	dahdahdahdahdit
5	dididididit	Ø	dahdahdahdahdah

Before commencing the study of the Morse characters it is expedient to accustom the ear to the sound of the elements of which all characters are composed. This is done by transmission of long series of dits and dahs at a speed corresponding to about 16 words per minute (= 80 letters per minute).

The correct relation in length between the elements of the signals and between the elements and their mutual space should already from the first hour of education be impressed. This can be illustrated in the following way:

dit:	1 time unit
dah:	3 time units
space between elements in a character:	1 time unit

For the sake of completeness the following spaces are also mentioned:

space between characters in a group (word):	3 time units
space between groups (words):	7 time units

The two last mentioned sizes are, however, not actual at this stage, as it is recommended to use increased space between characters and words.

During the learning of the Morse signals it is practical to divide the letters and other characters into groups in order to learn the most common letters first. Experience shows that the interest can better be retained if the students are able to understand real words already after a few hours of education instead of being forced to work solely with invented groups.

In no event should guessing take place. If a letter or a word is lost, skip it, and concentrate on the next. An attempt to reconstruct the lost letter or word very often causes that also one or more of the following signals or words are received faulty.

The division mentioned on the following pages can advantageously be used during the first time of the education. It should, however, be noticed that the word "lesson" does not necessarily mean one hour. A careful study of one lesson may often require more hours. Any fixed rule for this can hardly be given, as the ease with which the pupils learn the signals to a large extent varies from one person to another. As a general rule it must, however, be said that the instruction should not proceed further, until the pupils fully master the lesson.

It should also be an invariable rule that the characters from the previous lesson are repeated at the beginning of the following lesson.

On the other hand, it is not advisable that the students revise the characters by perusal of schemes etc. in which the signals are mentioned. The first education must take place via the ear and only via the ear. The teacher — or the assistant — whistles or pronounces the signals in dits and dahs or — and this way is recommended — he uses a loudspeaker and a key or a transmitter.

After a few lessons the usual instruction — according to which the student copies the words (groups) signal by signal — can advantageously be supplemented by short periods of transmissions of words in plain language. During these periods the pupil should try to memorize the words without copying them. After the transmission of a word the student repeats it. This practice is a very suitable help in the efforts to let the pupils conceive the Morse signals as a kind of a new language and not as a series of combinations of dots and dashes.

A proper "by-heart" learning of the characters should not take place. The listening practice is repeated so frequently that the pupil does not hear signals composing of certain elements. Instead of this he hears each single signal as a unit, a sound pattern.

The examples of groups and words mentioned in the following can be supplemented by other ones in cases where the circumstances make it desirable.

LESSON I

Characters: A didah
E dit
O dahdahdah
S dididit
T dah

Groups:	OESTA	EOSAT	STOSE	SAOTE	TSEOO
	ASTES	TSAEA	ETAOS	SOAET	OASET
	TAAST	SEOAE	STSOA	ESATT	ASETA
	OSTAS	SASTA	TSTOS	OEASE	SOSEA

Words: AS SO TO SEE TEA EAT OAT TOE SET ESSO TEST
EAST SEAT STATE TEASE TASTE TOAST TATTOO

LESSON II

New characters: H didididit
I didit
L didahdidit
N dahdit
R didahdit

Groups:	SINRO	NSELT	HSARL	NTHIO	NEOAR
	SOLAL	ITENR	OALNS	LSAHR	ENSTE
	HSOLA	IHORE	AHSSI	SELRA	LTENN
	ELSAN	TELER	HOINA	ELIOH	SIRNS

Words: ON NO THE SON HILL SAIL REAR ROLL NONE
REST HERE RATE LANE NEAR RENT NEST STILL
TREAT STONE NORTH LITTLE THRILL HOSTESS SESSION

LESSON III

New characters: C dahdidahdit
F dididahdit
G dahdahdit
U dididah

Groups:	FOTGS	AICUH	RFSAN	USCHI	GSONR
	UAEHT	IRLCS	ERGTO	RCHAT	GESUT
	HUASR	NGSEO	FTHIG	RISAU	GECOC
	SCFEI	UTRAF	GOFHO	IFHTA	USAHR

Words: OUT CUT CAST GULF HULL COST RUSH CROSS
FORCE LATIN TRUST GRILL STUFF FROST CLING
FRESH SOUTH AFRICA SAIGON HIGGINS AUSTRIA
FURNACE SHILLING FUNCTION AUSTRALIA

LESSON IV

New characters: D dahdidit
K dahdidah
M dahdah
P didahdahdit

Groups:	KOHPR	MCISG	FSUDE	OKDCA	PSHFK
	DTIEP	LKDDE	SGUMA	PGSNE	DOHGU
	UGHSA	IMRPA	UCTHM	GEIFA	MAGDP
	DLSNC	ADEOM	PIRL	CTDAP	UHSMT
	FTOSM	CFGKU	LNIOE	PSMKA	HUICF
	EFHIK	MAILG	TGUUD	SDKOP	HSUHP

Words: PERFORATED CODE SLIPS ARE PRODUCED AND FED
INTO MODIFICATED TRANSMITTER STOP MECHANICAL
REGULATOR ENSURES CONSTANT SPEED AND
PAUSES ARE INSERTED STOP IDEAL FOR MORSE
TRAINING SCHOOLS

LESSON V

New characters: B dahdididit
 Q dahdahdidah
 W didahdah
 Y dahdidahdah

Groups:	WRUHA	CPWAR	QUTHD	MIOYS	FLUBR
	SDMYP	GCBPW	AEIOY	TRWWG	NALFR
	IQWSO	YQLFB	CWPMO	IATFS	LUHPY
	LRNQP	MNRUD	KPOHI	YAWCS	BRUDP
	BWREI	DQLYR	ASITP	KQWPF	EKFCW
	SFYLA	TIHSS	PWFQCQ	BWGQS	TGULA

Words: SAMUEL FINLEY BREESE MORSE WAS BORN IN
 AMERICA STOP GOOD PRACTICE IN TYPEWRITING
 AND KEYBOARD PERFORATING STOP MORSEINKERS
 ENABLE TEACHER AND STUDENTS TO CHECK
 PROFICIENCY DURING EDUCATION STOP CORRECT
 PERFORMANCE IS OBTAINED BY MEANS OF
 TRANSMITTERS

LESSON VI

New characters: J didahdahdah
 V didididah
 X dahdididah
 Z dahdahdidit

Groups:	DQRIX	PVAJS	EZGNR	FXQYP	EHLBO
	PTUDV	IPHRC	DXVKP	LIEBH	TVYRH
	OSYZF	SZIGA	BOSJL	VKBWU	TCDON
	ECWVN	BXPYI	MJLKA	ZZIRT	OUCVZ
	RFSMV	MPPRO	KMINP	QSWIZ	HLLVO
	QLPWA	YRIOW	AJMVE	XPQAH	SZILM

As all the normal letters have now been learnt, the students are now able to copy any text from books, newspapers etc.

Special attention should be paid to the following letters which are often confused P - J, H - V, P - L, S - U, F - L, Z - Q, C - Y.

LESSON VII

New characters:	5	didididit
	0 (zero)	dahdahdahdah
	1	didahdahdah
	6	dahdididit
	4	didididah

Groups:	15	615	1664	61054	661554
	64	410	5104	41500	514101
	01	566	1546	16406	651450

LESSON VIII

New characters:	2	dididahdah
	7	dahdahdidit
	3	dididahdah
	8	dahdahdahdit
	9	dahdahdahdit

Groups:	79	238	1046	20355	141699
	41	715	4278	14743	741605
	32	430	1693	22310	605432
	42	011	0410	42867	149277
	65	614	2708	92106	614369
	90	250	6154	51381	247883

Sending

Most beginners want to use the Morse key from the first day of the education. This is, however, not advisable. The Morse key should not be taken into use until all the characters have been thoroughly worked in by sound.

The instruction in sending code should — in other words — not begin until the pupils are able to understand and write down unhesitatingly all the characters sent, whistled or pronounced by the teacher.

SENDING POSITION

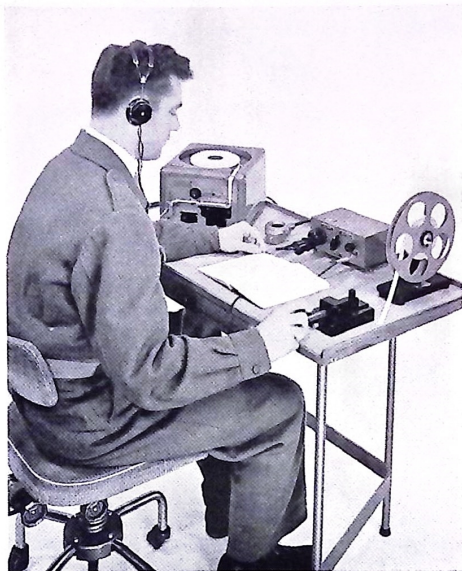


Fig. 1. Correct sending position.

It is very important that the sending position is correct already from the start.

The chair ought to be of a type that allows adjustment in height dependent on the student in question.

The table should never be so high that the pupil has to raise his one shoulder in a forced way.

The key is mounted (or placed) as near the edge of the table as possible.

The operator should sit upright in his chair facing the table directly. The body has to be straight, but at the same time relaxed and resting against the back of the chair.

The feet are placed with the whole of the balls resting on the floor, and the legs should not be stretched or placed the one upon the other.

The arms must be relaxed, the wrist flexible and the manner of grasping the key should be tight, but not tense.

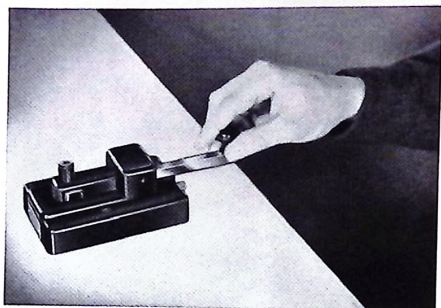


Fig. 2. Correct method of holding the Morse key.

As is seen from fig. 2 the knob of the key is grasped in the following way: The thumb is placed against the left edge of the knob, the forefinger on the top and lapping over the rear edge a bit. The middle finger should rest against the right edge of the knob, while the ring finger and the little finger are kept slightly curved, but never strained, without touching the key.

The grip should in no circumstances be loose, and the key never be flapped or beaten, as this manner of sending inevitably involves incorrectness in the Morse characters.

The movements are made by the wrist which should be kept straight and relaxed all the time. At the beginning of the education it is recommendable to enlarge the movements compared to those of a trained operator. The arm and the hand should not touch the table.

Some schools recommend a support of the elbow on the table. In this case the key must be mounted about 40—50 centimetres (16—20") from the edge of the table.

In fig. 3, 4, and 5 are shown some examples of inadequate hand positions during sending. In fig. 3 the key is released after the depression —

Fig. 3.
Wrong hand position.

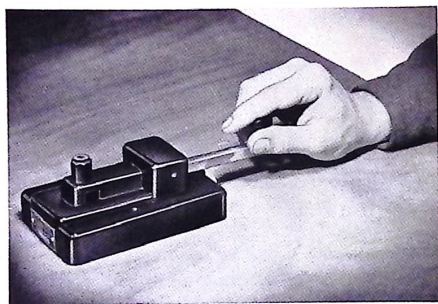
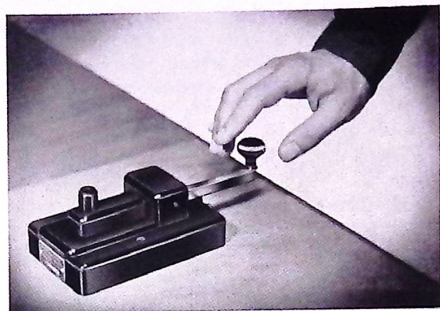
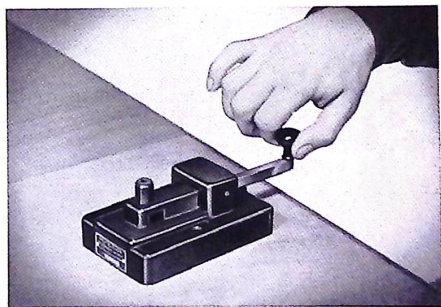


Fig. 4.
Wrong hand position.

Fig. 5.
Wrong hand position.



the characters are "flapped". In the next figure the arm and the wrist are resting upon the table, for which reason the movements connected to the depression of the knob have to take place partly by bending the fingers.

On fig. 5 the manner of grasping the key is wrong and the hand is tense.

All these methods cause that the hand and the arm get unnecessarily tired, and as a skilled operator must be able to work for hours without getting tired, it is exceedingly important that the above mentioned fundamental rules are carefully enjoined and followed.

The movements of the wrist should be the same whether dits or dahs are being sent.

It should be seriously enjoined on the students that a wrong or tense sending position very often causes "Morse-cramp" or synovial sheath inflammation.

KEY ADJUSTMENT

As it will be seen from fig. 6 the Morse key is provided with an adjustment screw (placed near the rear edge of the key) by means of which the space between the contacts of the key can be varied. Normally this space should be wide enough to allow a vertical movement of about 1.5 mm (.060") of the knob of the key. During the first part of the education time it is, however, advisable to use a somewhat wider contact space.

On some telegraph keys the tension of the spring — which draws the lever of the key back to its resting position after each depression — may also be varied. The adjustment of this spring tension is dependent on the individual requirements, as some operators prefer a heavier spring than others. On the key shown in fig. 6 the spring tension screw is placed below the key lever.

Generally speaking you can say that a too heavy spring tends to make the sending "choppy", while a too light spring tension may involve a tendency to scamp the characters.

Forming Characters

LESSON 1

Before starting the training with the proper Morse signals the students should carefully practice the correct movements of the hand. This is best done by sending several series of dits — 10—20 in a row — whereafter groups of dahs are sent, then again dits and so on. This first part of the training is utmost important and should not be neglected. The teacher must see that the dits and dahs have the correct mutual length, i. e. that the dahs are three times as long as the dits.

This practice ought to be repeated at the beginning of every lesson of sending.

It has proved to be inadequate to use a very low speed in the start. The series should already from the first lesson be sent on a speed corresponding to at least 40—60 letters per minute.

The spaces between the characters and between the words should on the other hand be increased very considerably at first. The actual speed must be kept on a level at which a minimum of errors is made.

By enabling the teacher to check each pupil's work the Morseinker offers immense advantages; the teacher as well as the pupil himself can at any time ascertain whether there are incorrectnesses in the sending, whereafter the faults can be corrected.

For this reason it is advisable that all the students have such Morseinkers at their disposal.

As a matter of fact the use of Morseinkers also leaves the teacher much more time to control the students' work, their position etc. during their work, thus enabling him to ascertain the faults at a very early stage of the education. As it has proved to be very difficult to correct a faulty position etc. when this has become a habit, this fact is of course of the greatest importance.

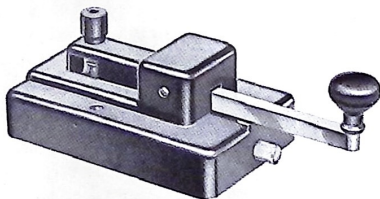


Fig. 6. GNT Morse Key Model 605.

That the tape of a Morseinker furthermore shows possible incorrectnesses much clearer than any verbal explanation goes without saying.

The figure below, No. 7, shows a Morseinker especially designed for Morse training purposes.



Fig. 7. GNT Morseinker Model 1532.

Once the pupils master to send uniform series of dits and dahs, and the position of the body and the arm is correct and unconstrained during the work, the training of the Morse characters can be opened.

This practice is divided into various groups. It is noticed that the characters in each group are more or less associated.

The word "lesson" does not necessarily mean that it shall last only one hour of instruction to learn the letters in question. One lesson very often requires several hours of practice before it is advisable to proceed further.

In any case it is very important that each lesson is gone over again and again, and if any difficulty is observed in the performance of the Morse signals, then go back to the previous lesson or send new series of evenly spaced dits and dahs until the wrist again works smoothly and relaxed.

LESSON 2

Characters: E dit
I didit
S dididit
H didididit
5 dididididit

Groups:	IS5HI	5SHHE	ESIHE	S5ISE	E5EIS
	S5HIS	H5EEI	EHS5I	5EHSS	HII5S
	EIHSI	S5HEH	5E5HI	IHEH5	IESE5
	HSIE5	5ISEH	ESH5I	IESHI	H5SEI
	I5SEI	SEEHH	ISE5S	EISSH	E5ISH

Words: HE IS SHE HIS SEE

The teacher should at short intervals inspect on the tape of the Morse-ink that the dits are precise and evenly spaced. If they are not, the student must repeat the sending of several series of dits.

LESSON 3

New characters: T dah
M dahdah
O dahdahdah
Ø (zero) dahdahdahdahdah

Groups:	TI5MØ	SHOTM	M5IØH	SMEEØ	MOISØ
	IMOS5	ØH5SE	IO5TØ	SMEHT	5TEIM
	OØ5IE	HE5OT	MØHET	IMØTS	HØHSI
	IMMS5	ØOE5E	STMEØ	IHSMØ	SMTES
	HØSIT	MOS5I	ØTESH	MTOSØ	ETSMH
	IMEHO	OSMØH	SOMHI	ETMOH	ØSMIO

Words: IT IS SO TO ME HE SIT SET HIM HIT THE TOE
HOT TIE SHOE MISS STEM THIS OHMS ESSO

LESSON 4

New characters: A didah
U dididah
V didididah
4 dididididah

Groups:	MEU4S	5IØAT	UT5I4	HMSAV	ØUSV5
	4MHAI	ØTVIM	ATU5I	VS5HU	4TØHM
	TOV54	HMUSA	UØH4I	EVHOT	MVU4I
	VTSOE	ITAVM	MSVOE	AEO5S	TUSV4
	ØSTMI	VHØTE	UAMI4	TVOSØ	4A5SH
	UHI5E	HEMØV	5OMEV	ASH4M	IU4ØA

Words: AS US TEA USE EAT SAM SEA HAM SAT HAT
HEAT EASE MEAT OATS SEAT MOST SAVE TEAM
MOVE TEASE HOUSE TASTE

Special attention should be paid to the numeral 4 as experience shows that this character often causes the pupil a great deal of trouble. Further, the letters V and U are very often confused with each other.

LESSON 5

Repetition: E, I, S, H, 5, T, M, O, Ø, A, U, V, 4

Groups:	TIOUE	4TMSH	AUTHE	4IEOM	UHVMS
	SMØAH	OSIØS	HEEOA	USHHT	ØSEO4
	5VAIS	5AVSM	HOIUM	4MSEA	UTHØS
	MØ5VI	EOASU	UIT4H	SØVSE	OHMV5
	EØMUS	IUØHM	VH5MO	SEAVT	4HITE
	VHMIA	AMVE5	UITOE	AIUMV	VIEM5
	ØEEVT	MUTVS	OAEST	EH4TA	ØHIUT

If any difficulty in regard to a certain letter is observed, you should repeat it until the difficulty has been completely overcome.

LESSON 6

New characters: N dahdit
D dahdidit
B dahdididit
6 dahdidididit

Groups:	ADHO4	B5USE	NOTS6	4ØEMI	BOMSN
	6TOVE	AHNVB	ID6B4	T6BHE	MEDI5
	NBMHS	ON5BT	HMTØE	ØUOVI	N5S4M
	Ø4SNO	M6EO4	OSE5V	V4TET	DAU54
	5DSMH	UBHIM	BNMIT	SDATV	MBHST
	UT4BV	SØ4DE	U5VIH	M4VH6	BMVHE

Words: BE ON NO TIN NUT SON BIT ANT BUT DAN
ONE BET MAD MAN BUSH MODE HAND TENT
BOOM BAND ETON SEND TONE SAND INTO
TINT NONE SENT DOTS SENSE STONE DASHES
SEVENTEEN

LESSON 7

New characters: W didahdah
J didahdahdah
1 didahdahdahdah

Groups:	U65WE	HAJON	ID5MS	4WVST	EB416
	ØTISO	J5UB6	WAISM	VTA6J	OSØ61
	NA5UW	SWMIE	UBV61	6BHNU	HWVIA
	J5T6U	MØ4WN	HMTJO	HSWØJ	BV641
	VIBSM	HDØ61	Ø6UTH	S5U4W	MBHV4
	UTDJW	BUAVT	DWTSJ	T4JNB	ETMBU

Words: WE JOE SAW JET WON WET JAM MAD WIN
SUN SEW TIM NOW JEWS SEEN WHOM JAVA
WINE HAVE WHEN WHAT WIND SHOW MEETS
DEATH SHINE VIVID WHEAT WISHES

LESSON 8

New characters: G dahdahdit
9 dahdahdahdahdit
Z dahdahdit

Groups:	BMGZO	J4MED	V6GHZ	GMWZ4	JNASZ
	UHE5W	UVØ61	4NBAN	DUWEG	MØ6JS
	1UTO6	VSIØH	U61VH	Z964B	NSV4I
	VSEJ9	6VJMG	TGMO9	NG4ØT	HGIGD
	GSU4V	9OSWD	6VABJ	94VTS	WUJIA
	TMVIU	ASBMØ	WSI96	ZUST4	M6UAG

Words: ZOO GOT TWO SIGN GOAT WING JAZZ DUST
UNIT SEVEN MIGHT SHOWS BEGIN BEHIND ZIGZAG
SMOOTH DESIGN GETTING UNEVEN STUDENTS
ADDITION

LESSON 9

New characters: R didahdit
F dididahdit
L didahdit

Groups:	TFMNL	IDJ59	FZHØE	WLMSO	GROTU
	UM6NF	MRZJ6	W91DU	IHB9L	D9HLS
	NIF6A	4ITJS	OIJGZ	F5RNT	J4061
	DØIZF	HNEGJ	LW46N	IWT5L	Ø9WFF
	HL5MB	ZVUGW	TMZSA	WMOFZ	RUVL6
	6AMWG	NTMZI	VØU4B	GVHID	4Z9MO

Words: RE LOW RUN SLIM WORD FISH FROM FLOW
REAL LEDA SHOW RADIO FLING MOTOR BLOCK
LARGE DRIFT WHILE MORSE WHEEL DRIVEN OUTFIT
TABLES RIBBON VARIOUS WIRING RELATIVE
TRAINING NORTHERN WIRELESS TRANSMIT ESTABLISH

LESSON 10

New characters: 2 dididahdahdah
3 didididahdah
7 dahdahdididit
8 dahdahdahdidit

Groups:	6H3AT	WUJ97	ENVG3	81547	SHO6T
	LIF4D	GR27I	LGMJ5	TSHGZ	B9Z70
	TØ543	LNH4E	SØD63	OVUE6	NØTVJ
	L5G9F	810ØH	LHVIZ	DAUDH	MBLF6
	GBTWG	WZJG8	5HABN	09ZGF	UWO5I
	LEG95	9NØHE	DIZTG	738RW	GJF7A
	ULB79	MZVI4	HESWZ	OEST6	Ø6534
	GEISØ	VMIGL	JB78I	H4L6J	IAU23
	BU739	IHMT8	WAZUL	RIM73	OLF7R
	Ø8FSJ	D39MV	26LWZ	GR18F	RGØST

These numerals are sometimes giving the students some trouble. Special attention should, therefore, be paid to avoid extra spacing between dots and dashes.

LESSON 11

New characters: K dahdidah
X dahdididah
P didahdahdit

Groups:	J4X52	PLHIØ	BW3GZ	9TUVZ	GL7KM
	EAWX3	7AVTU	NGJIL	Ø6UTZ	NGKUX
	97T5P	XWJ9I	6IMEL	BGLR6	FKUPN
	AMD6I	GØLTX	Z69S5	043W1	6LNDK
	OSIH4	NGV3X	RMDJ9	XW4ZR	KGS59
	LØHXT	ML3X7	KGJDN	O4DBZ	LV5Ø7

Words: LABOUR OUTPUT SIMILAR ENGLISH FURTHER
HUNDRED PURPOSE MESSAGE AMATEUR PARALLEL
AUDIBLE DIAGRAM TERMINAL EARPHONE AMPLIFIER
PROGRAMME TELEPHONE HORIZONTAL ALPHABET
TENNESSEE BRIGHTEST DESTINATION MEMORIZING
APPROXIMATE INTERFERING RESIDENTIAL
APPROPRIATE MORSEINKER SIMULTANEOUS

LESSON 12

New characters: C dahdidahdit
Q dahdahdidah
Y dahdidahdah

Groups:	MA3ID	8RTBJ	BIEWV	K8SRT	T3ENF
	7HSIK	YCW5L	UIGØL	48JWA	BQCYV
	NB9LC	LM61G	VCRFO	MNADG	73641
	K5OIQ	B4ERZ	P37FG	ZGLWP	NG6UR
	G9OVC	QLS4H	OLE4S	H97XP	QZWD1
	MPQSZ	XUWG8	OØLRS	546BV	Ø3YGC

Words: A PENNY SAVED IS A PENNY GAINED ILL BLOWS
THE WIND WHICH PROFITS NOBODY A LIAR
SHOULD HAVE A GOOD MEMORY WHERE THERE
IS A WILL THERE IS A WAY FORGET ABOUT DOTS
AND DASHES GOOD WORK IS A MATTER OF
PRACTICE PREVENTION IS BETTER THAN CURE

LESSON 13

New characters: Period . didahdidahdidah
Comma , dahdahdidahdah
Double dash = dahdidididah
Question mark ? dididahdahdidit

Groups:	46.39	YWGRF	SLHPQ	19Ø,6	XAWCR
	BNJOI	43682	=	VMWGZ	?
	8.975	CJQWT	LXKYS	,	19926
	BLZRO		SNGWH	UANGQ	PZLRC
	914,3	O.AVT	=	LBJQY	76421
	?	YHCFG	BLATD	JZKQO	432.8

From this stage you will be able to use the text from old telegrams, books etc. as routine material.

As an excellent anti-guessing device the use of "intentional error sentences" can be recommended, for instance: "A rolfig stoni gatsers no mosh".

LESSON 14

New characters:	Error		didididididit
	Apostrophe	'	didahdahdahdit
	Oblique stroke	/	dahdididahdit
	Bracket, l. h.	(dahdidahdahdit
	Bracket, r. h.)	dahdidahdahdidah

Groups:	RQLWJ	67/412	(KEY)	SQZPW	FYIMO
	BEN'S	3/14/6	FBECW	=	AMP/H
	?	54/738	(7186)	297.41	KM/LTR
	EISH'	64375	(WPM)	4.2.1	QJZXY

LESSON 15

New characters:	Colon	:	dahdahdahdididit
	Semicolon	;	dahdidahdidahdit
	Hyphen	—	dahdidididah
	Quotation marks	"	didahdidahdit

LESSON 16

Special symbols:	Understood	didididahdit
	Attention	dahdidahdidah
	Invitation to transmit	dahdidah
	Wait	didahdididit
	End of message	didahdidahdit
	End of work	didididahdidah

SENDING ROUTINE

Morse is going to be a new language for the student — it must be a real language if he wants to become a skilled operator.

You will have to think in code, to whistle in code, to read in code, to tip with your finger nails in code upon your writing table. The headlines from the newspapers are read in code, the neon signs are coded, street signs are visualized in code. You should think subconsciously of code whenever you see words. — In fact you have a fair chance to become a nuisance for your family and your surroundings, but luckily only for a shorter time.

However, the spare time training is likely to be one of the most important single factors in the Morse-learning work.

Like the well-trained typist who writes the words without looking at the keys and without thinking of their position, you must be able to send code and to copy code in longhand or on a typewriter while thinking of something else or while carrying on a conversation with someone. If you cannot do this, you are not yet quite code-minded.

It is very typical of the skilled operator that if you ask him about the contents of the message he has just sent or received by code, he usually knows nothing. His subconsciousness and — of course — his hand have done the work for him, and done it in a better and more dependable way than if he had been thinking of the meaning of the message or of the single words.

There is, however, a last thing that ought to be mentioned in connection with sending routine: A telegraphist should never try to "overdrive" his own ability and should remember that a transmission at a moderate, but constant speed very often settles the traffic more quickly than a very fast, but erratic transmission.

"BUG" OR "VIBROPLEX" SENDING

In order to reach higher speeds than obtainable on an ordinary key a so-called "Bug" or "Vibroplex" key can be used.

The main difference between this semi-automatic instrument and the normal, "straight" key is that the "Bug" key automatically produces a series of dits when the operator moves the key to the right hand side, while dahs are made when moving the knob to the left. The operating motions are, in other words, horizontal and not vertical.

The fact that the operators need not produce every single dit, but just have to contact the right vibrating contact, quite naturally means that a somewhat higher speed may be obtained.

However, it should be strictly dissuaded even to touch a "Bug" key until full proficiency in handling the ordinary key and — do not forget this — in receiving Morse code has been obtained.

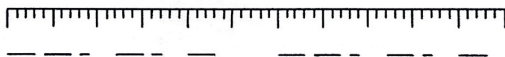
If you start using a "Bug" key before that stage you are very likely to embarrass your sending ability most seriously.

The International Morse Alphabet

TIME DURATION SCHEME

Dot	■	1 time unit
Dash	■	3 time units
Space between elements	□	1 time unit
Space between characters	□	3 time units
Space between words	□	7 time units

EXAMPLE



LETTERS

A	— — — — —	N	— — — — —
B	— — — — —	O	— — — — —
C	— — — — —	P	— — — — —
D	— — — — —	Q	— — — — —
E	— — — — —	R	— — — — —
F	— — — — —	S	— — — — —
G	— — — — —	T	— — — — —
H	— — — — —	U	— — — — —
I	— — — — —	V	— — — — —
J	— — — — —	W	— — — — —
K	— — — — —	X	— — — — —
L	— — — — —	Y	— — — — —
M	— — — — —	Z	— — — — —

NUMERALS

1	— — — — —
2	— — — — —
3	— — — — —
4	— — — — —
5	— — — — —
6	— — — — —
7	— — — — —
8	— — — — —
9	— — — — —
0	— — — — —

PUNCTUATION MARKS

Period	.	— — — — —
Comma	,	— — — — —
Double dash	=	— — — — —
Question mark	?	— — — — —
Apostrophe	'	— — — — —
Oblique stroke	/	— — — — —
Bracket, l. h.	(— — — — —
Bracket, r. h.)	— — — — —
Colon	:	— — — — —
Semicolon	;	— — — — —
Hyphen	—	— — — — —
Quotation marks	"	— — — — —

SPECIAL SYMBOLS

Error	— — — — —
Understood	— — — — —
Attention	— — — — —
Invitation to transmit	— — — — —
Wait	— — — — —
End of message	— — — — —
End of work	— — — — —

Special letters which may be used between countries permitting them

ä	— — — — —
á, à, â	— — — — —
ã	— — — — —
ç	— — — — —
ch (German)	— — — — —
é, è	— — — — —
ñ (Spanish)	— — — — —
ö	— — — — —
ü	— — — — —

Automatic Morse Equipment

In order to increase the capacity of a telegraph line most government stations and commercial companies all over the world are now using automatic machines in their work. The two principal systems are the Morse system and the teleprinter or 5-unit system.

The high speed Morse instruments are preferably used on international radio circuits while teleprinters are now dominantly used on the majority of national networks.

The teleprinter system is based on a code employing 5-units, each signal thus having the same duration. The printing takes place directly from the signals.

In this booklet, however, only the Morse system will be mentioned.

The principal instruments of this system are:

1. Keyboard Perforator
2. Transmitter
3. Undulator
4. Relay
5. Reperforator
6. Printer

1. KEYBOARD PERFORATOR



Fig. 8. GNT Keyboard Perforator Model 50.

By means of this apparatus a perforated tape is produced. It is provided with a keyboard of almost the same appearance as an ordinary type-writer.

When depressing a key the Morse character is punched in a paper tape which in turn is fed forward to a length corresponding to that of the signal, thus providing blank tape for the succeeding character. In the keyboard perforator shown above a special locking device prevents the simultaneous depression of more than one key, a feature which prevents many errors.

The above perforator has a maximum speed of operation of about 750 characters per minute which leaves a good margin for even the most experienced operator.

In fig. 9 a short piece of a perforated tape is shown.

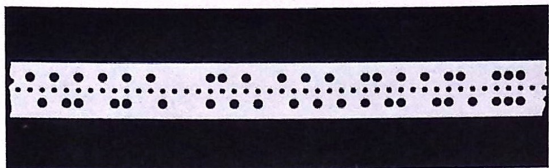


Fig. 9. Perforated tape.

2. TRANSMITTER

The perforated tape is then fed into a transmitter in which two peckers are "sensing" the punched holes in the tape and transforming these holes into dots and dashes direct to the line.

The transmitter shown below in fig. 10 has a speed range of 13—250 words per minute and is provided with a speed regulator that keeps the speed constant at any setting even in spite of considerable variations of the supply voltage.

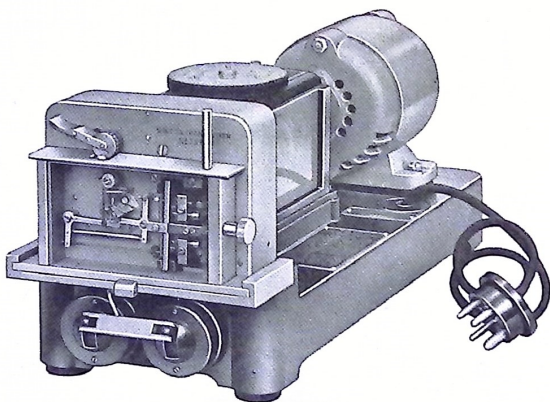


Fig. 10. GNT Transmitter Model 112.

3. UNDULATOR

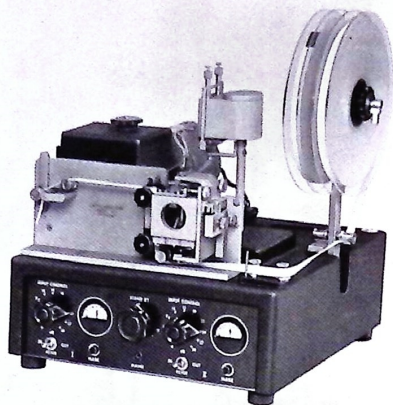


Fig. 11. GNT Undulator model 312.

On the receiving station the signals may be received on an undulator. Basically this equipment consists of an ink-fed pen mounted at the end of a lever that is activated by the incoming Morse signals.

The pen rests lightly on a paper tape moved by a motor and represents the received dots and dashes in outline form as shown below.

When transcribing this tape the operator often makes use of a tape puller by means of which the tape passes across the front of the telegraphist's typewriter, on which the contents of the message is copied. Fig. 13 shows such a tape puller provided with a knee switch and arranged for pulling one or two undulator tapes past a typing position.

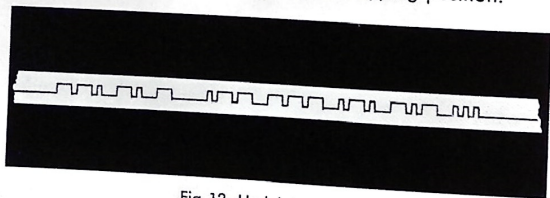


Fig. 12. Undulator tape.

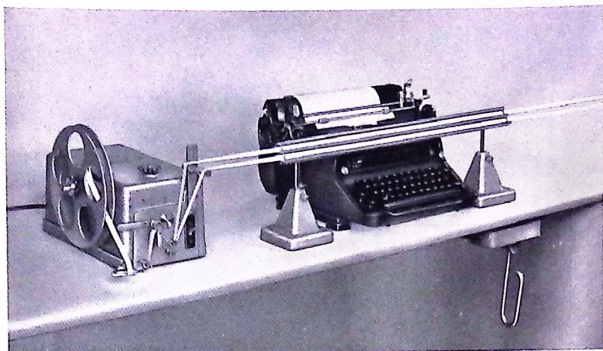


Fig. 13. GNT Tape Puller model 2040.

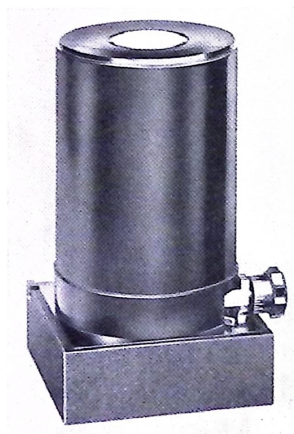


Fig. 14. GNT Relay
model 1137 with cover.

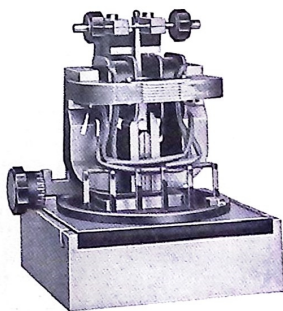


Fig. 15. GNT Relay
model 1137 without cover.

4. RELAY

Sometimes the above mentioned system is carried a step further by receiving the signals on a polarized relay (fig. 14 and 15) which feeds a reperforator that produces a perforated tape identical with the transmitted tape.

5. REPERFORATOR

This instrument (shown in fig. 16) consists of a motor, a speed regulator covering the speed range 40—200 words per minute, a synchronizing arrangement ensuring that the receiver keeps phase with the signals, and a perforating mechanism.

The reperforator is well suited for radio and land line working and has found widespread use all over the world, where the Morse system is employed. It is the fastest existing receiving reperforator for Morse and it ought to be mentioned that its performance at the highest speed is about 10,000 holes punched per minute.

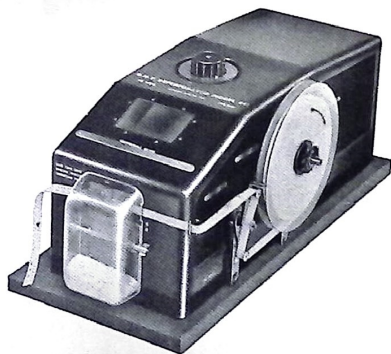


Fig. 16. GNT Reperforator model 451.

6. MORSE PRINTER

The tape received on the reperforator can be used either for retransmission into a line or for feeding a Morse printer converting the perforated tape into text printed on a blank tape which is then pasted down on a telegram form.

A modern Morse printer is shown on fig. 17.

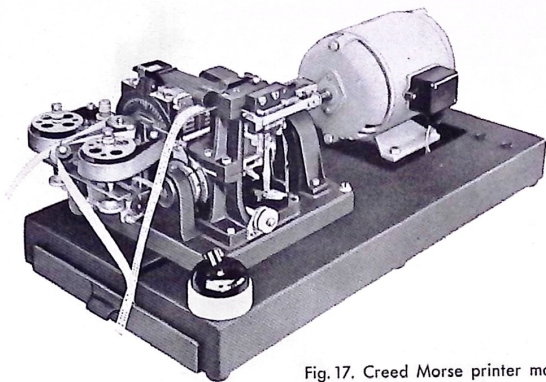


Fig. 17. Creed Morse printer model 1-T.

This way of receiving telegrams is preferred by many telegraph administrations having relations with the public, as it enables the operators to cut out errors in the tape, or paste them over, so that these errors do not appear in the telegram form delivered to the addressee.



Fig. 18. GNT Gumming Machine model 2047.

Fig. 18 shows a gumming machine, a glue-box, for pasting down printer, or undulator, tape on telegram forms. The simple box design ensures that the gum keeps moist for long periods.

Morse Training School

A. TIME-TABLE FOR EDUCATION

	1st week	2nd-6th week	7th-13th week	14th week	*)
1. hour	R	R	R	R	R
	E	S	S	S	S
2. hour	E	E	E	E	A
	R		A	A	
3. hour	E	R	R	R	R
	R	S	S	S	S
Pause					
4. hour	R	R	R	T	W
	L	S	S		
5. hour	L	L	T	R	W
	R		L	S	
6. hour	L	R	R	G	W
	R	S	S	L	
			P	P	W

Fig. 19. Time-Table.

*) The last weeks of the education usually comprise also practical work — among other things telephony training — at the school's radio station(s).

It will hardly be possible to prepare a time-table that can be used everywhere, as the requirements vary from country to country — from school to school. It goes without saying that the requirements of an army training school are different to those of, for instance, commercial schools.

For this reason the time-table for education mentioned on page 42 should only be understood as a proposal on the basis of which the real time-schedule could be built.

SYMBOLS - EXPLANATION

- R = Receiving
- S = Sending
- E = Electrology and Radio Technics
- A = Instructions of Apparatus and Fault Tracing
- T = Telegraph Regulations and Telegrams Service
- P = Pasting down of telegrams
- L = Language
- G = Geography
- W = Practical Work (incl. telephony training)

B. TRAINING SCHOOL EQUIPMENT

As a complete and ideal Morse equipment for a training school the following instruments can be proposed:

1. GNT Switchboard model 3072
2. GNT Keyboard Perforator model 50
3. GNT Transmitter model 115
4. GNT Tone Generator model 3060
5. GNT Morse Key model 605
6. GNT Morseinker model 1532
7. GNT Undulator model 312
8. GNT Rectifier model 2057
9. GNT Gummed Tape Server model 2050
10. GNT Paper Wheel model 2087
11. GNT Tape Winder model 2081
12. GNT Student's Box model 3080.
13. Carbon Microphone
14. Headphones
15. Loudspeaker

16. Radio Receiver
17. Tape Recorder
18. Signal Mixing Unit
19. Dynamic Microphone.

The necessary number of the various instruments (Morse Keys, Morseinkers, Student's Boxes, microphones, headphones etc.) depends on the number of students in each single case. An absolute maximum for a class should, however, be 30 pupils; beyond that limit a real effective education is impossible. Preferably a class should not consist of more than 20—25 pupils.

1. THE TEACHER'S SWITCHBOARD GNT MODEL 3072

is made as a metal panel on the front of which is mounted the linecommutator containing 36 vertical and 24 horizontal crossbars by means of which all connections between the students' instruments and the teacher's instruments are established.

The panel is further provided with fuses and main switches for the mains supply of three groups of Morseinkers and likewise fuses and switches for the 12 volts DC supply of three groups of students' working tables.

2. THE GNT KEYBOARD PERFORATOR MODEL 50

shown on fig. 8, page 36, is a very robust instrument. The normal speed of its cam spindle is 750 r. p. m.

3. GNT TRANSMITTER MODEL 115

A modern transmitter especially intended for educational purposes as it permits the insertion of a pause between the transmitted letters and words. By means of this arrangement the pupils get the proper "sound picture" of the signals from the first day of the school.

The speed range, 5—35 words per minute, is covered by simply turning a calibrated dial on the top.

The instrument is provided with a mechanical speed regulator which keeps the speed constant even in spite of considerable variations of the supply voltage.

The length of the pauses can be varied very easily by turning a calibrated knob behind the transmitter head.

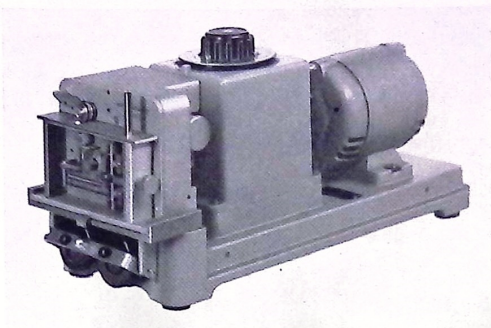


Fig. 20. GNT Transmitter model 115.

4. GNT TONE GENERATOR MODEL 3060

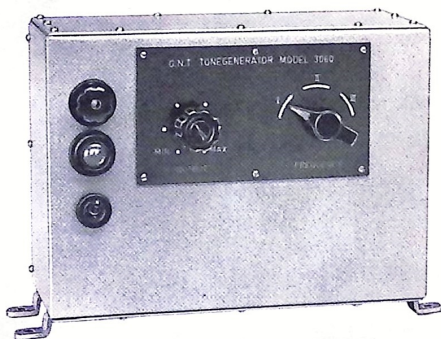


Fig. 21. GNT Tone Generator model 3060.

This instrument is designed for three different tone-frequencies, normally 600, 900, and 1200 cycles per second, with an output power of about 3 watts in a load impedance of 66 or 7 ohms.

5. GNT MORSE KEY MODEL 605

Shown in fig. 6, page 23. The 605 key is mounted in a strong bakelite housing and arranged so that all accessible parts are free of electrical potential, the actual contacts being nevertheless visible for inspection.

6. THE GNT MORSEINKER MODEL 1532

which is seen on fig. 7, page 24, is an instrument specially designed for training purposes. It enables the teacher to check the pupil's proficiency in Morse keying at any time and in a much clearer way than by any other method.

7. GNT UNDULATOR MODEL 312

Fig. 11, page 38.

By means of this instrument – that is provided with two pens – the inspector can simultaneously take record of the keying of any student and of the transmitting source giving master signals to the student. On the tape thus produced all possible faults can clearly be studied.

8. THE GNT RECTIFIER MODEL 2057

serves to supply 12 volts DC for the telephony training.



Fig. 22. GNT Rectifier model 2057.

9. THE GNT GUMMED TAPE SERVER MODEL 2050

provides gummed wafers readily wetted for joining transmitter, or undulator, tape together before it is wound up on a paper wheel.

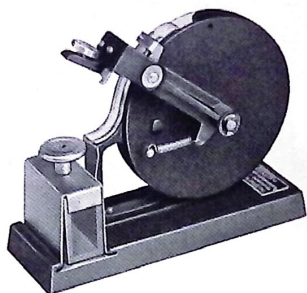


Fig. 23. GNT Gummed Tape Server model 2050.

10. GNT PAPER WHEEL MODEL 2087

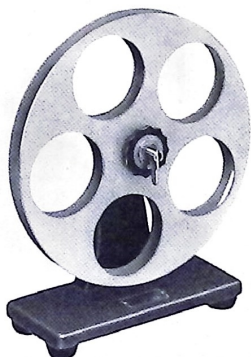


Fig. 24. GNT Paper Wheel model 2087.

11. THE GNT TAPE WINDER MODEL 2081

is intended for pulling and winding up tapes from undulators, Morseinkers, and similar instruments.

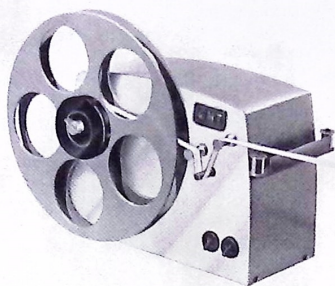


Fig. 25. GNT Tape Winder model 2081.

The speed of this motor driven winder is automatically adjusted by means of a slipping friction clutch inserted between the motor and the paper wheel.

Furthermore, the 2081 Tape Winder is provided with automatic stop for taut tape.

12. THE GNT STUDENT'S BOX MODEL 3080

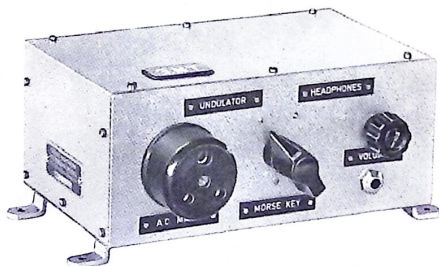


Fig. 26. GNT Student's Box model 3080.

contains terminal strips for in and outgoing connections, jacks for head-phone etc. and a switch for change-over between different modes of operation.

13. CARBON MICROPHONE

with an approximate impedance of 70 ohms.

The figure below shows the right way to hold the microphone.



Fig. 27. Carbon Microphone.

14. THE HEADPHONES

are double headphones to be fitted on the head by means of a flexible spring. The impedance of each earphone is 2000 ohms.

15. LOUDSPEAKER

A moving coil cone-speaker mounted in a bakelite cabinet. Impedance 7 ohms.

16. RADIO RECEIVER

A robust model should be chosen.

17. A TAPE RECORDER

of a sturdy performance.

18. THE SIGNAL MIXING UNIT

serves to mix different signals which are being simultaneously recorded by means of the tape recorder, for example a transmitter signal with radio noise as background or two transmitter signals with different tone frequency and of different telegraphic speeds.

The signal mixing unit is of GNT-make.

19. A DYNAMIC MICROPHONE

of an applicable type.

C. Morse Practice Arrangement

On the following diagrams an arrangement for Morse telegraphy and radio telephony is described.

The diagram No. I shows the various apparatus at the teacher's table and at one of the 30 students' working tables.

The line-commutator arranged in the teacher's switchboard, diagram No. I, has 36 vertical crossbars, one for each student's table plus 6 auxiliary crossbars, and 24 horizontal crossbars of which the 15 lower ones are reserved for individual establishing of groups of students working together (maximum 15 groups of two students). The upper nine crossbars are used together with the six auxiliary vertical crossbars for making connections to the various transmitting and receiving instruments at the instructor's table.

By means of the said six plus nine crossbars the teacher may form groups of students listening to or receiving from the various transmitting instruments. Likewise the instructor is able to listen in or make a record of any student's work by means of his receiving and/or recording instruments.

The connections between the two sets of crossbars are made by plugs.

The following modes of working are possible:

TELEGRAPHY TRAINING

a. Diagram No. II

The students are listening to loudspeaker signals and copy these with their Morse keys, hearing their own signals in the earphones and/or making records of their own signals by means of their Morseinkers, operated by tone.

b. Diagram No. III

The students are listening with one earphone to master signals received via the line-commutator from a transmitter or the tape recorder or the teacher's Morse key and copy these signals with their Morse keys at the same time listening with the other earphone to their own keying (split listening).

If desired, visible records may be made simultaneously by means of the students' Morseinkers, operated by tone.

c. Diagram No. II or III

The students are operating their Morseinkers with the Morse key plugged directly to the "key" terminal of the Morseinkers.

This mode of working may be used either to follow loudspeaker master signals or solely to show the students visible records of their own keying without assisting master signals. The Morse key's connection is shown with dotted lines.

d. Diagram No. II

Two or more students may correspond together by means of tone signals to be heard in their headphones. Visible records of the correspondence can be produced simultaneously by means of their Morseinkers.

The students' outfits are in this case interconnected via one of the lower fifteen crossbars of the line-commutator at the instructor's table.

TELEPHONY TRAINING

e. Diagram No. IV

Two to three students may correspond together by means of hand-microphone and headphones.

Connections between the students are established via the students' line-commutator as indicated on the diagram.

The teacher may listen in, if desired, by connecting his telephone set in parallel with the students' sets, as shown with dotted lines in the diagram.

Over the fifteen lower crossbars in the line-commutator it is possible to establish in all fifteen telephone channels for fifteen pairs of students.

f. Diagram No. V

shows a schematic, complete wiring diagram for a student's working table.

TEACHER'S CONTROL

As seen from the block diagram No. I the instructor has the following possibilities for controlling the work of any student or group of students:

Telegraphy:

By means of the **two-pen Undulator GNT 312** the teacher can simultaneously take records of the keying of any student and of the transmitting source giving master signals to the student. On the tape thus produced all possible faults can clearly be studied.

Likewise the instructor by means of his Morseinker may correspond with any student and/or make records of his key training.

From the block diagram will be seen that the teacher's Morse set figures as a student set No. 31 and may be connected to any student's set by means of a free horizontal crossbar and two plugs.

Audible record of any student's work may be made also by means of the **tape recorder**. For this purpose the student's vertical crossbar is directly connected to the uppermost horizontal crossbar marked I by means of one plug, this crossbar leading to the input of the tape recorder.

It will be understood that tape records may be made of work with telegraphy as well as telephony.

The teacher may thus for the whole class, if desired, demonstrate particularly fine work as well as examples of bad working.

The main use of the tape recorder should normally be its application as a means for recording and retransmission of any desired programme, especially programmes mixed up with interfering noise which may form a background of interfering telegraph signals, atmospheric, disturbing telephony etc.

The tape recorder is of a model designed for stereophonic sound reproduction thus being able to make records on two sound tracks at the same time. The two records may be played back simultaneously either on two separate lines or mixed on a common outgoing line. In the latter case the volumes of the two outputs from the sound tracks may be freely adjusted in any required relation to one another.

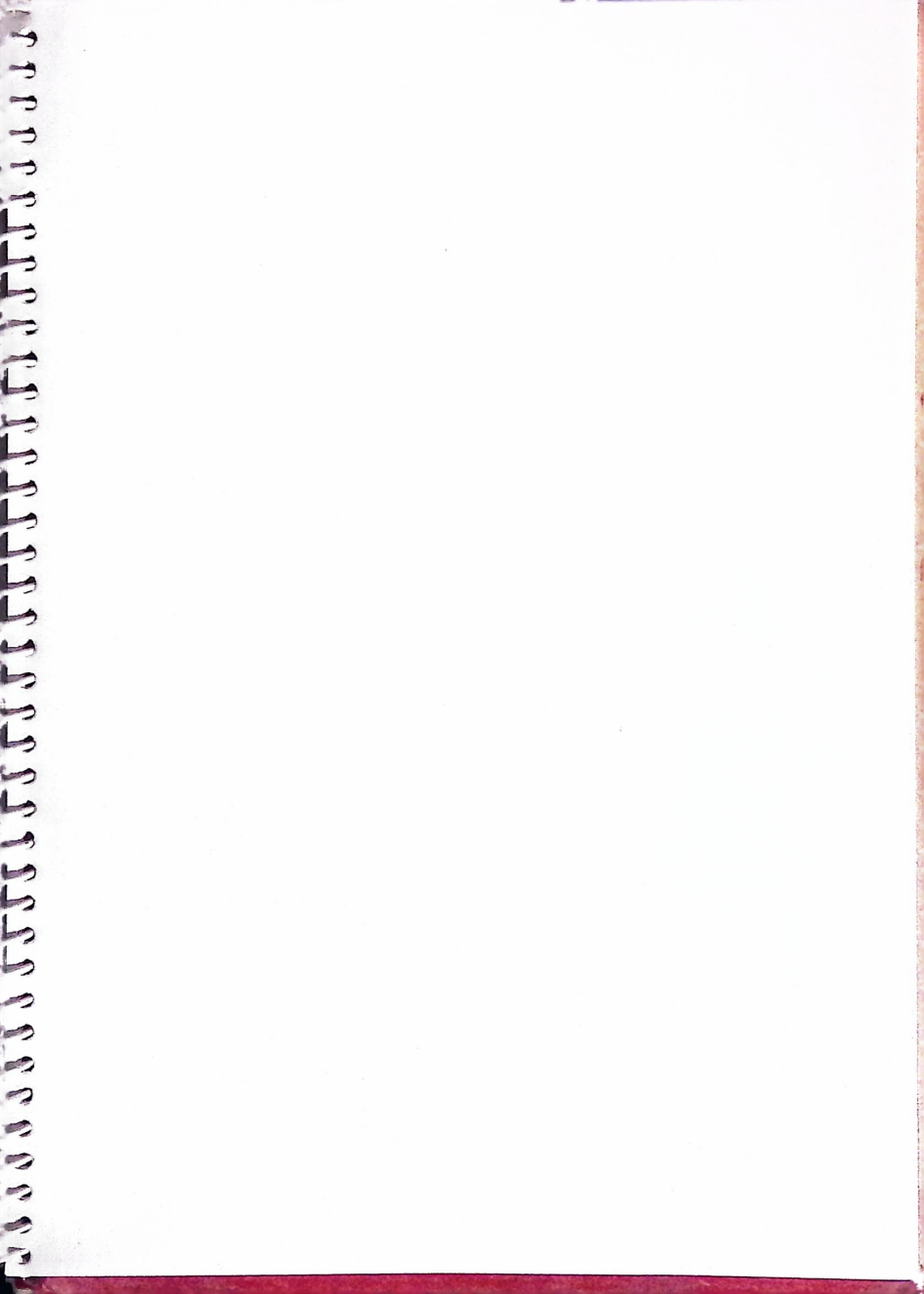
Naturally the sound tracks may be played back one at a time, the total recording time for a tape reel thus being doubled.

By means of a separate dynamic microphone the teacher may make records of an entire lecture or of comments to accompany the programme in question.

Telephony:

As mentioned above the teacher may listen in on any group of students working with telephony.

As seen from the block diagram No. 1 the instructor only has to connect his vertical crossbar No. 31 to that horizontal crossbar which connects the two or more students whose work the teacher should wish to check.



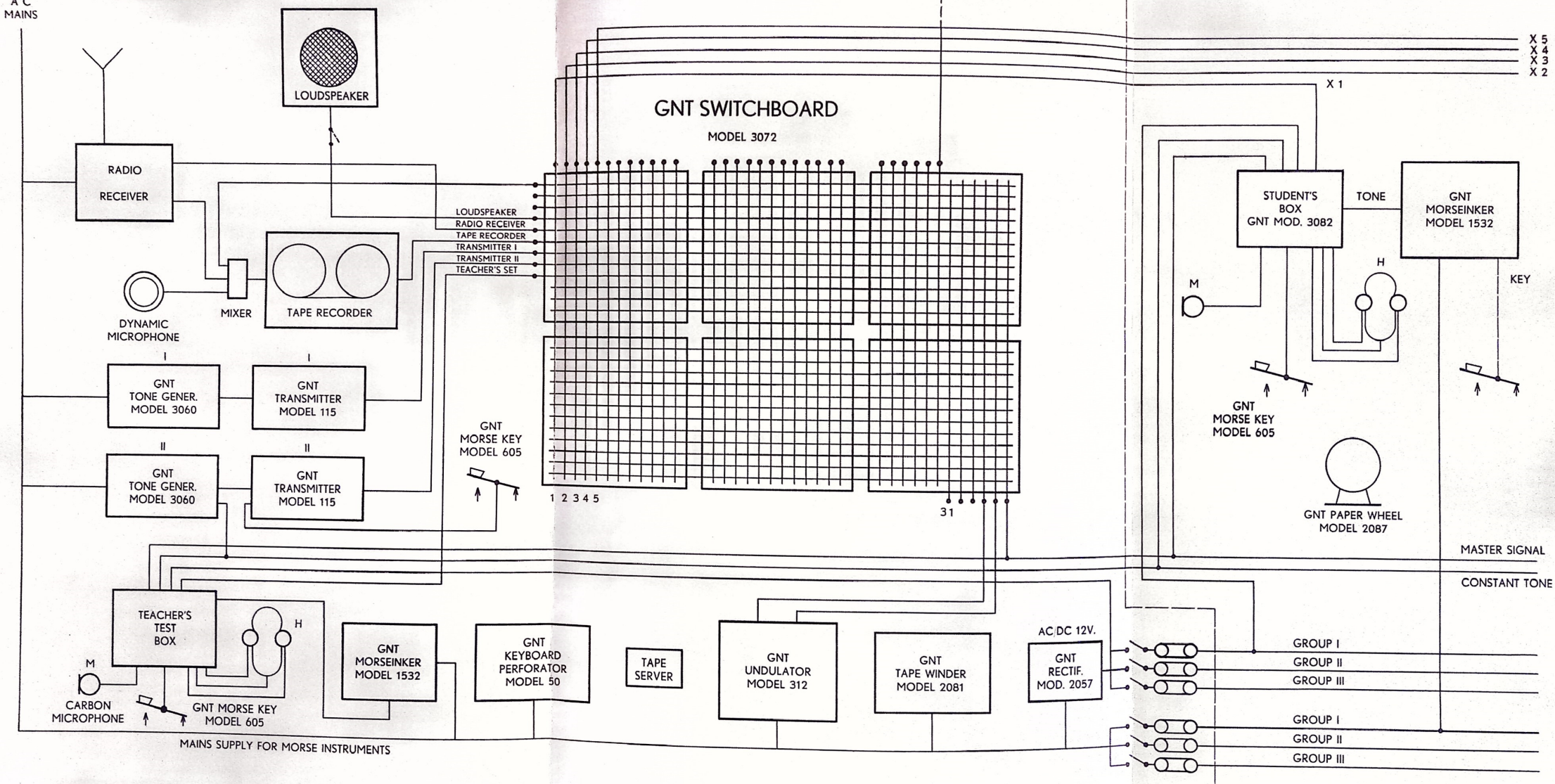
TRAINING SCHOOL FOR MORSE TELEGRAPHY AND RADIO TELEHONY

TEACHER'S TABLE

STUDENT'S TABLE NO. 1

A C
MAINS

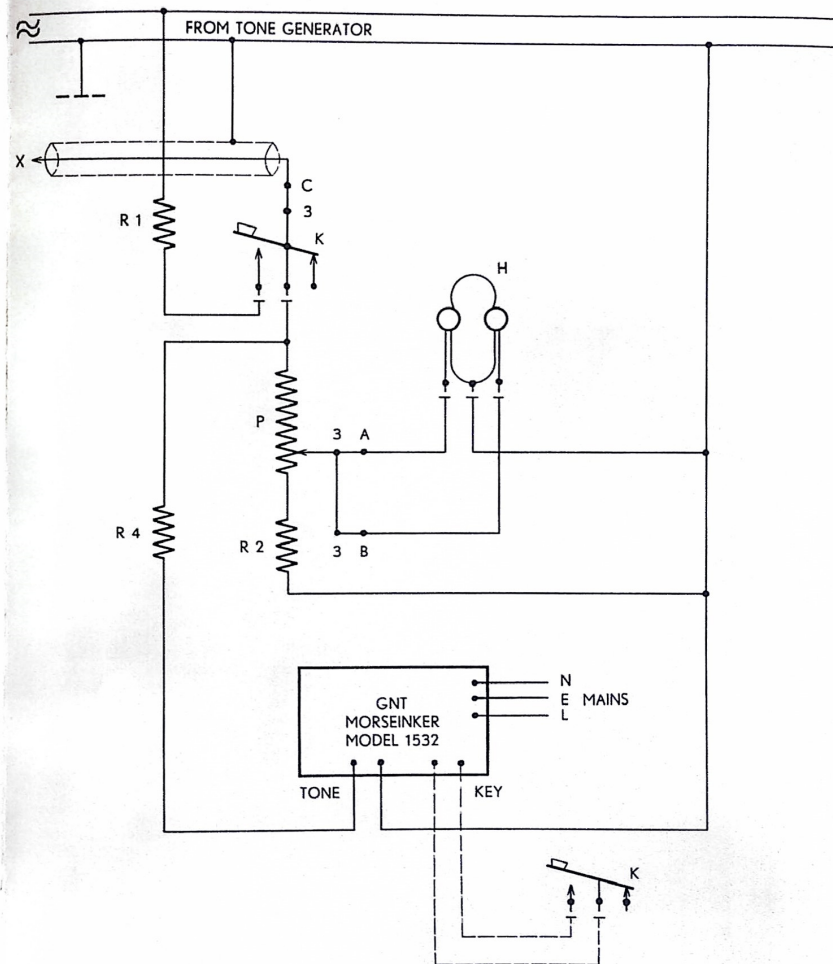
—SCHEMATIC DIAGRAM—



II STUDENTS' WORKING TABLES

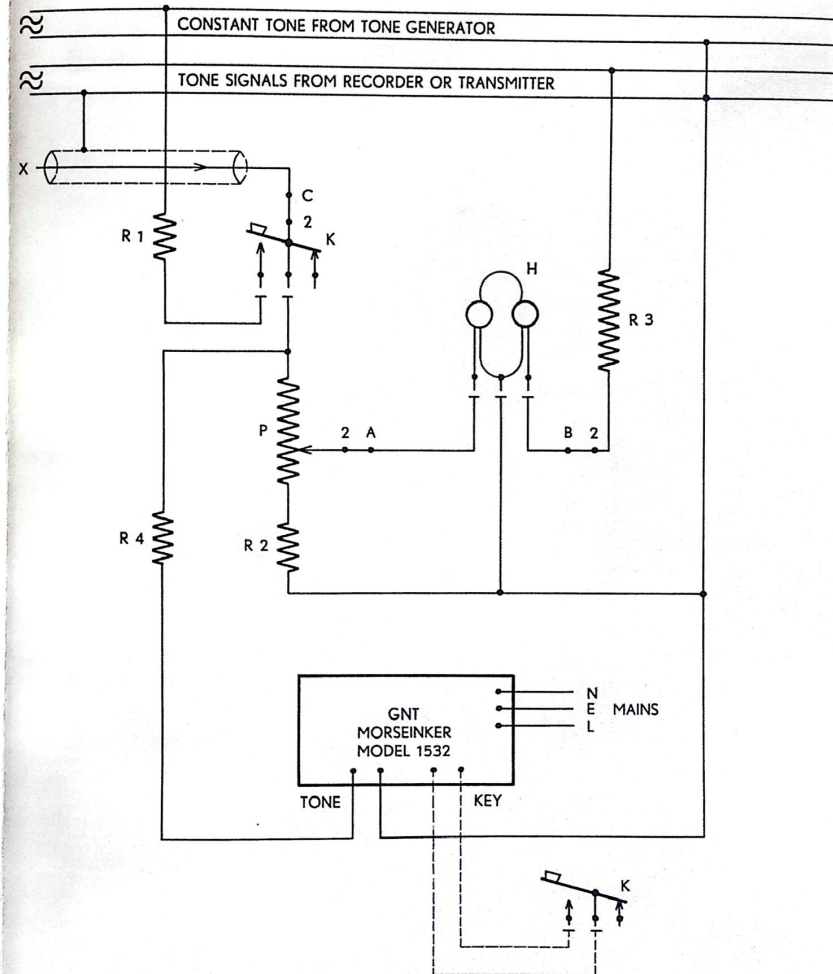
KEY-TRAINING WITH MORSEINKER AND HEADPHONES

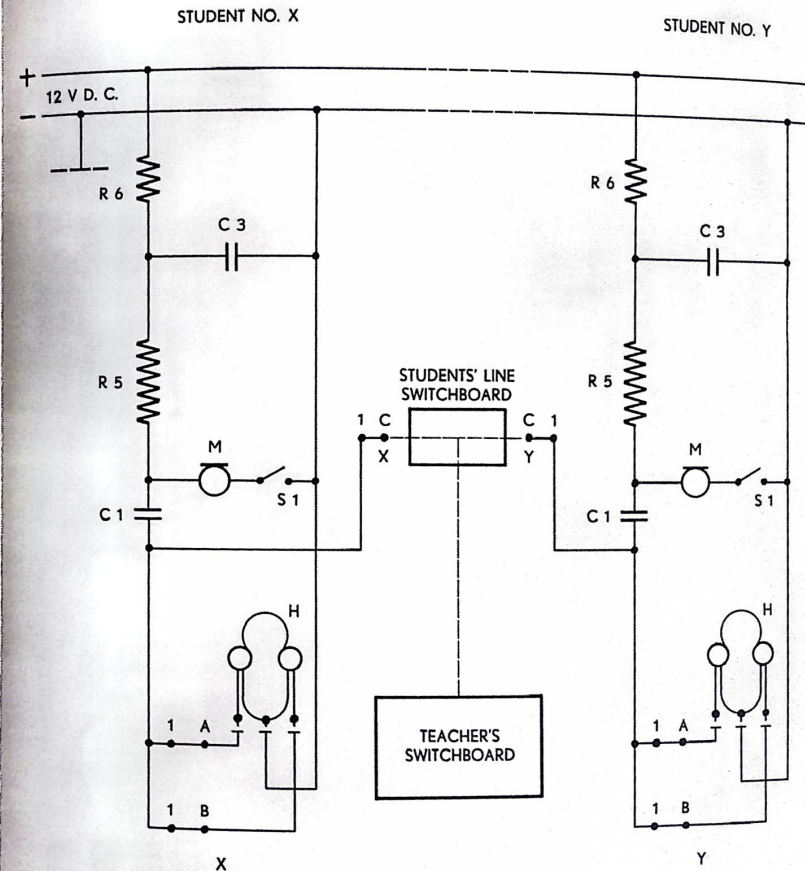
STUDENTS ARE WORKING SINGLY OR IN PAIRS



STUDENTS' WORKING TABLES

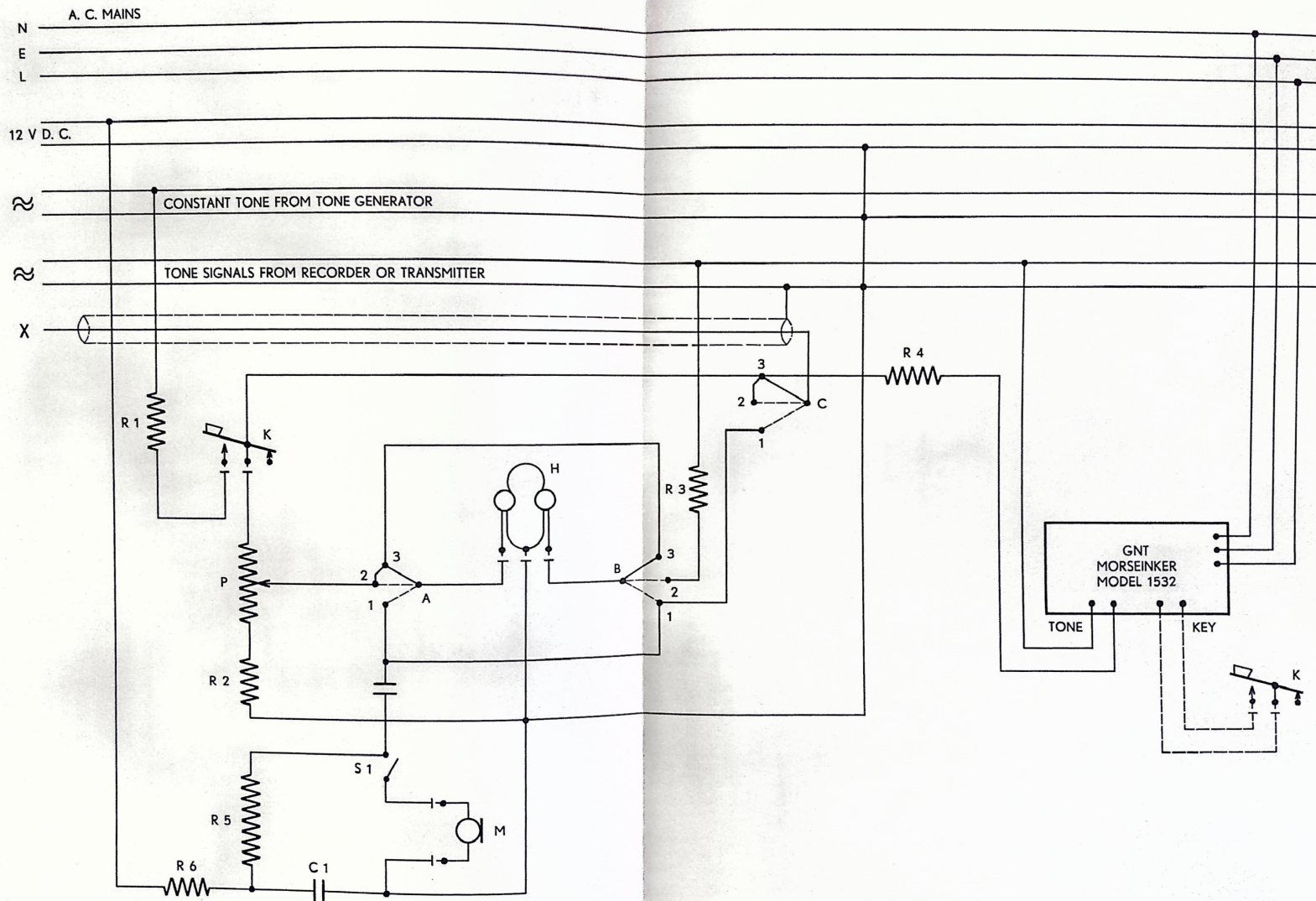
KEY-TRAINING TIMED FROM MASTER SIGNALS (SPLIT LISTENING)
(SIMPLIFIED WIRING DIAGRAM)





STUDENTS' WORKING TABLES

COMPLETE SCHEMATIC WIRING DIAGRAM





G. N. T. Works have specialised in the manufacture of telegraph instruments for more than 80 years and have developed many instruments of advanced design.

G. N. T. telegraph instruments combine high quality with competitive prices.

G.N.T.